CLAIMS

1. A thermoelectric conversion material having a multi-column structure comprising a porous body having columnar pores and a semiconductor material that can perform thermoelectric conversion introduced into the pores of the porous body, characterized in that the porous body is formed by removing a column-forming material containing a first component from a structure in which a plurality of columns of the column-forming material are distributed in a matrix containing a second component that is eutectic with the first component.

2. A thermoelectric conversion material having a multi-column structure, characterized in that the column structure is obtained by:

providing a porous body having a plurality of columnar pores which is formed by removing from a structure in which a plurality of columns of a column-forming material containing a first component are distributed in a matrix containing a second component that can form an eutectic with the first component,

introducing into the pores a semiconductor material that can perform thermoelectric conversion; and then

removing the porous body.

3. The thermoelectric conversion material according to claim 1, wherein the porous body is in a thin film.

4. The thermoelectric conversion material according to claim 1, wherein the multi-column structure is obtained by further chemically treating the porous body and then introducing the semiconductor material into the pores.

5. The thermoelectric conversion material according to claim 4, wherein the chemical treatment is an oxidation treatment.

6. The thermoelectric conversion material according to claim 1, wherein the first component is aluminum; the second component is silicon; and the structure contains silicon at 20 atomic% or more and 70 atomic% or less.

7. The thermoelectric conversion material according to claim 1, wherein the first component is aluminum; the second component is germanium; and the structure contains germanium at 20 atomic% or more and 70 atomic% or less.

8. The thermoelectric conversion material according to claim 1, wherein a main component of the porous body other than oxygen component is silicon.

9. The thermoelectric conversion material according to claim 1, wherein a main component of the porous body other than oxygen is germanium.

10. The thermoelectric conversion material according to claim 1, wherein the average diameter of columns in the structure is 0.5 nm or more and 15 nm or less.

11. The thermoelectric conversion material according to claim 1, wherein the average spacing of columns in the structure is 5 nm or more and 20 nm or less.

12. The thermoelectric conversion material according to claim 1, wherein part of the column-forming material is a crystalline material, and the matrix is an amorphous material.

13. A thermoelectric conversion device using a thermoelectric conversion material according to claim 1.

14. A manufacturing method of a thermoelectric conversion material comprising the steps of:

providing a structure in which a plurality of columns of a column-forming material containing a first component are distributed in a matrix containing a second component that is eutectic with the first component;

removing the column-forming material to form a porous body; and

introducing a semiconductor material into pores of the porous body.

15. The manufacturing method according to claim

14, comprising a step of chemically treating the porous body after the removal step.

16. The manufacturing method according to claim 14, wherein the chemical treatment is an oxidation treatment.

17. The manufacturing method of thermoelectric conversion material according to any one of claim 14 to 16, wherein the introduction step of the semiconductor is electrodeposition.

18. A structure comprising a plurality of columns of a column-forming material and a matrix surrounding the columns, wherein the columns have a Seebeck coefficient at a room temperature larger than that of the material in bulk solid.

19. The structure according to claim 18 wherein the columns are placed on a substrate, and substantially perpendicular to a surface of the substrate.

20. A thermoelectricity conversion device comprising on a substrate, a structure which comprises columns of a column-forming material and a matrix surrounding the columns, wherein the columns have a Seebeck coefficient larger than that of the material in a bulk solid at room temperature, and the columns are electrically connected to electrodes; and the device generates current flow in response to thermal change of outside.